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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ⁶ : A01N 37/12, 37/44, 43/50, 43/58, 43/60,	A1	(11) International Publication Number: WO 95/29588
47/10, A61K 31/27, 31/50, 31/195, 31/415, 31/495		(43) International Publication Date: 9 November 1995 (09.11.95)
(21) International Application Number: PCT/US9 (22) International Filing Date: 21 April 1995 (2)		European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR,
(30) Priority Data: 08/234,089 08/413,742 28 April 1994 (28.04.94) 30 March 1995 (30.03.95)	_	Published With international search report.
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(54) Title: SYNERGISTIC WATER SOLUBLE PRESERVATIVE COMPOSITIONS OF BIOCIDAL MIXTURES

(57) Abstract

A water soluble preservative admixture of biocidal compounds for addition to commercial use compositions at predetermined use levels, and uniformly distributed therein, to provide long-time synergistic biocidal activity against a wide range of fungi and both gramnegative and gram-positive bacteria, which comprises powders of (a) one or more methylol compounds, or their equivalents, and (b) iodopropynyl alcohol, or its ester, carmabate or ether derivative thereof, in a weight ratio of (a):(b) of 100:1 to 2000:1.

SYNERGISTIC WATER SOLUBLE PRESERVATIVE COMPOSITIONS OF BIOCIDAL MIXTURES

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to a water soluble preservative admixture for addition to commercial use formulations to provide long time synergistic biocidal activity therein, and, more particularly, to admixtures of a methylol compound and an iodopropynyl compound, in predetermined weight ratios of 100:1 to 2000:1.

2. Description of the Prior Art

Combinations of antimicrobial agents have been developed in the prior art in order to:

- (1) produce a biochemical synergism;
- (2) broaden the antimicrobial spectrum of activity of each agent;
- (3) increase water solubility for the admixture;
- (4) minimize the toxicity or irritation of a given agent to the host; and
- (5) minimize physical and chemical incompatibilities.

True biological synergism exists when two agents, when combined, require lesser amounts of the agents to bring about the same inhibitory or cidal effect than either single agent alone. While synergistic interaction for two or more antimicrobial agents does produce more than merely an additive effect in the resultant biological activity, in most cases the mechanism of such synergism remains a mystery.

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M. Rosen et al., in U.S. Patent 4,844,891, for example, described a preservative admixture of (a) a formaldehyde donor and (b) a halopropynyl compound, in a weight ratio of (a):(b) of 50:1 to 1:1, preferably 30:1 to 2:1, and, most preferably, 20:1 to 10:1, as providing fungicidal activity for 1-3 days in commercial use formulations. However, Rosen observed that when the ratio of (a):(b) in the concentrate exceeded 50:1 (System No. 16 in Table 1, a ratio of 73.33), the preservative composition was ineffective in providing biocidal protection in the use formulations. Thus a relatively large amount of the halopropynyl compound was required by Rosen to provide significant biocidal activity in the use composition. In such admixtures, although the formaldehyde donor is water soluble, the halopropynyl compound is substantially insoluble in water. Therefore it was difficult for Rosen to uniformly distribute his admixture throughout the use composition.

For these and other reasons, it is desired to provide a new and improved water soluble preservative admixture of such biocidal compounds which requires relatively little of the water insoluble and expensive halopropynyl compound, and that also provides effective synergistic protection in use formulations against a wide range of fungi and bacteria at different use levels over a long period of time.

A feature of the present invention is the provision of an admixture concentrate which is water soluble and which therefore can be uniformly distributed in use compositions at a predetermined use level.

Another feature herein is the provision of a preservative admixture which exhibits a long term synergistic biocidal activity against wide range of fungi and both gram-negative and gram-positive bacteria in the use compositions.

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Still another feature of this invention is the provision of a water soluble preservative admixture for personal care compositions in the form of a solution, lotion, gel, emulsion, emulsifiable concentrate, suspension, slurry or cream.

These and other objects and features of the invention will be made apparent from the following more particular description of the invention.

SUMMARY OF THE INVENTION

What has been discovered is a water soluble preservative composition for addition to commercial use compositions at predetermined use levels, and uniformly distributed therein, which provides long term synergistic biocidal activity against a wide range of fungi and both gram-negative and gram-positive bacteria. The composition of the invention comprises an admixture of powders of

- (a) a methylol compound, or their equivalent, and
- (b) iodopropynyl alcohol, or its ester, carbamate or ether derivative thereof, in a weight ratio of (a):(b) of 100:1 to 2000:1, preferably 200:1 to 500:1.

Commercial use compositions containing about 0.01 to 2% by weight of the composition of the invention also are provided therein. Such use compositions contain an iodopropynyl compound in an amount of about 0.5 to 10 ppm, to provide the desired antifungal activity, and a methylol compound, or equivalent thereof, in an amount of at least 250 ppm, to provide the desired antibacterial activity.

In another embodiment of the invention the composition also includes propylene glycol or 1,3-butylene glycol.

DETAILED DESCRIPTION OF THE INVENTION

The invention is based upon the discoveries that in a predetermined admixture of (a) a methylol compound, or its equivalent, and (b) an iodopropynyl compound:

- (1) Iodopropynyl compounds are substantially water insoluble at weight ratios of (a):(b) of less than 100; accordingly, at weight ratios below 100:1, it is difficult to uniformly distribute the iodopropynyl compound in aqueous use compositions, particularly in creams, gels and the like. In this invention, the admixtures are used at a weight ratio of (a):(b) of 100:1 to 2000:1, which are water soluble in all use compositions at conventional use levels.
- (2) Effective synergistic biocidal activity is achieved for admixtures having a weight ratio of (a):(b) of 100:1 to 2000:1. Such admixtures have a Synergistic Index (SI) value approaching zero (maximum synergism) for a wide range of organisms. In contrast, admixtures with (a):(b) ratios below 100:1, e.g. 10:1 to 50:1, are much less synergistic, and are active with only a narrower range of organisms.
- (3) Preservative activity for use compositions is achieved most effectively with an admixture wt. ratio of 100:1 to 2000:1 at use levels of 0.05 to 2% by weight of the finished product. In this amount, the iodopropynyl compound is present in an amount of only 0.5-10 ppm, which significantly reduces the cost and toxicity of the use composition. The methylol compound also is present in an amount of at least 250 ppm.

The experimental results upon which these discoveries are based are described below. In these examples, the (a) methylol compound may be selected from diazolidinyl urea (GERMALL® II) N-[1,3-bis(hydroxy-methyl)-2,5-dioxo-4-imidazolidinyl]-N,N'-bis(hydroxy-methyl) urea, imidurea (GERMALL® 115),

1,3-dimethylol-5,5-dimethyl hydantoin (DMDMH), sodium hydr xymethylglycinate (SUTTOCIDE A), glycine anhydride dimethylol (GADM), dimethylhydroxymethyl pyrazole, (1-(3-chloroallyl)-3,5,7-triaza-1-azoniaadamantane chloride (a methylol equivalent), 1,3,5-(trishydroxy-ethyl)hexahydrotriazine, or hydroxymethyl pyrrolidone; and the (b) iodopropynyl compound is iodopropynyl alcohol (IPGA) or 3-iodo-2-propynylbutyl carbamate (IPBC).

1. WATER SOLUBILITY

The water solubility or insolubility of admixtures of several methylol compounds with IPBC as 1% aqueous solutions is shown in Tables A through C below.

TABLE A Amount in ppm	Solubility	
5	Soluble	
10	Soluble	
20	Soluble	
50	Soluble	
100	Soluble	
200	Insoluble Insoluble	
500		
TABLE B		
Amount		
	Solubility	
Amount	Solubility Soluble	
Amount in ppm		
Amount in ppm	Soluble	
Amount in ppm 5	Soluble Soluble	
Amount in ppm 5 10 20	Soluble Soluble Soluble Soluble	
Amount in ppm 5 10 20 50	Soluble Soluble Soluble	
	Amount in ppm 5 10 20 50 100 200	

TABLE C

Weight Ratio of DMDMH:IPBC	Amount in ppm	Solubility		
2000:1	. 5	Soluble		
1000:1	10	Soluble		
500:1	20	Soluble		
200:1	50	Soluble		
100:1	100	. Soluble		
50:1	200	Insoluble		
20:1	500	Insoluble		

These results demonstrate that admixtures having a ratio of 50:1 or 20:1 are insoluble in water whereas at ratios of 100:1 to 2000:1 the admixtures are soluble in water.

2. SYNERGISM

Tables 1 through 14 below demonstrate the very effective synergistic interaction between compounds "a" and "b" against a broad range of fungi and both gramnegative and gram-positive bacteria. The following organisms were tested:

ATCC

Organism	Number	Inoculum Concentration						
Ps. aeruginosa (PSA)*	9027	2.1 x 10 ⁶ CFU/gm of Product						
E. coli (ECOLI)*	8739	4.7 x 10 ⁵ CFU/gm of Product						
Staph. aureus (SA) **	6538	1.6 x 106 CFU/gm of Product						
Ps. cepacia (PC)*	25416	1.6 x 106 CFU/gm of Product						
C. albicans (CAN)***	10231	8.0 x 104 CFU/gm of Product						
A. niger (AN)***	16404	2.7×10^5 CFU/gm of Product						
Table D belo	ow lists	the static (MIC) and cidal						
activities of several antimicrobial agents in ppm. These								
activities are used to calculate the Synergism Index (SI)								
of admixtures of the present invention.								

[#] gram-negative bacteria

^{**} gram-positive bacteria

^{***} fungi

TABLE D

Static (MIC) and Cidal Activities of Several Antimicrobial Compounds (Static/Cidal Concentrations in ppm)

Organism					
(Arcc #)	IPBC	Germall® II	GADM	DMDMH	TPGA
(SA) (6538)	100/200	400/1600	400/800	450/1600	300/5000
(ECOLI) (8739)	50/100	400/1600	400/800	400/800	150/600
(PSA) (9027)	800/1200	400/1600	400/400	600/1600	70/70
(PC) (25416)	1200/1800	200/400	200/400	600/1600	70/300
(CAN) (10231)	50/100	1500/15000	7500/15000	8000/16000	50/300
(AN) (16404)	50/100	3200/3200	1600/3200	8000/16000	30/30

The Synergism Index was determined by the same mathematical treatment of such data described by Kull et al. in Applied Microbiology 2,538-541 (1961) using the following relationship:

Synergism Index (SI) =
$$\frac{Q_h}{Q_a}$$
 + $\frac{Q_B}{Q_b}$

where:

- 1. $Q_a =$ The quantity of Compound a acting alone, producing an endpoint.
- 2. Q_b = The quantity of Compound b acting alone, producing and endpoint.
- 3. $Q_A =$ The quantity of Compound \underline{A} in mixture, producing an endpoint.
- 4. $Q_B =$ The quantity of Compound <u>B</u> in mixture, producing an endpoint.

When SI is equal to 1, a mere additive effect of the components in the mixture is indicated; when SI is less than 1, synergism has occurred; and when SI is greater than 1 it indicates antagonism of the two components.

According to this well known method of measuring synergism, the quantity of each component in the various mixtures is compared with the quantity of pure component that is required to reach the same endpoint or to produce the same microbiological effect as the mixture.

TABLE 1
2000:1 Wt. Ratio GERMALL® II/IPBC

<u>Use Leve</u>	l Organism	0,	O _b	Q _A	O _B	sı
0.01%	SA	200	1600	0.05	99.95	0.06
••	ECOLI	100	1600	0.05	99.95	0.06
**	PSA	1200	1600	0.05	99.95	0.06
89	PC	1800	1250	0.05	99.95	0.08
Ħ	CAN	100	15000	0.05	99.95	0.01
H	AN	100	3200	0.05	99.95	0.03
					•	
Use Level	Organism	O _a .	o _b	O _A	Q _B	sı
0.025%	SA	200	1600	0.125		0.16
**	ECOLI	100	1600	0.125		0.16
. #	PSA	1200	1600	0.125		0.16
\$2	PC	1800	1250	0.125	249.9	0.20
"	CAN	100	15000	0.125	249.9	0.02
**	AN	100	3200	0.125	249.9	0.08
Use Level	Organism	O _a _	o _b	O _A	O _B	SI
0.05%	SA	200	1600	0.25	499.8	0.31
11	ECOLI	100	1600	0.25	499.8	0.31
H	PSA	1200	1600	0.25	499.8	0.31
9T	PC	1800	1250	0.25	499.8	0.40
99	CAN	100	15000	0.25	499.8	0.04
P1	AN	100	3200	0.25	499.8	0.16
				:		
<u>Use Level</u>	Organism	O _a	•		ż	
0.10%	SA	200	O _b	O _A	O _B	SI
11	ECOLI			0.5	999.5	0.63
**	PSA	100	1600	0.5	999.5	0.63
99		1200	1600	0.5	999.5	0.63
**	PC	1800	1250		999.5	0.80
**	CAN	100	15000	0.5	999.5	0.07
**	AN	100	3200	0.5	999.5	0.32

TABLE 1 (CONT)

<u>Use Level</u>	Organism	O _a .	O _b	O _A	O _R	SI
0.20%	SA	200	1600	1	1999	1.25
tt	ECOLI	100	1600	1	1999	1.26
98	PSA	1200	1600	1	1999	1.25
••	PC	1800	1250	1	1999	1.60
**	CAN	100	15000	1	1999	0.14
Ħ	AN	100	3200	1	1999	0.63

<u>Use Level</u>	Organism	Q _a	Q _b	O _A	O _B	si
0.40%	SA	200	1600	2	3998	2.51
**	ECOLI	100	1600	2	3998	2.52
er	PSA	1200	1600	2	3998	2.50
80	PC	1800	1250	2	3998	3.20
10	CAN	100	15000	2	3998	0.29
41	AN	100	3200	2	3998	1.27

<u>Use Level</u>	Organism	O _a	<u>Q</u>	Q ₂	On	_ si
0.50%	SA	200	1600	2.5	4997.5	3.14
D9	ECOLI	100	1600	2.5	4997.5	3.15
99	PSA	1200	1600	2.5	4997.5	3.13
99	PC	1800	1250	2.5	4997.5	4.00
n	CAN	100	15000	2.5	4997.5	0.36
**	AN	100	3200	2.5	4997.5	1.59

TABLE 2
1000:1 Wt. Ratio GERMALL® II/IPBC

Use Leve	l Organism	0	aO _b	O _N	O _B	sı
0.01%	SA	200	1600	0.1	99.9	0.06
Ħ	ECOLI	100	1600	0.1	99.9	0.06
**	PSA	1200	1600	0.1	99.9	0.06
**	PC	1800	1250	0.1	99.9	0.08
17	CAN	100	15000	0.1	99.9	0.01
93	AN	100	3200	0.1	99.9	0.03
						5.03
Use Level	Organism	0	O _b	O _A .	O _B	SI
0.025%	SA	200	1600	0.25	249.8	0.16
*1	ECOLI	100	1600	0.25	249.8	0.16
**	PSA	1200	1600	0.25	249.8	0.16
**	PC	1800	1250	0.25	249.8	0.20
87	CAN	100	15000	0.25	249.8	0.02
••	MA	100	3200	0.25	249.8	0.08
Ugo Town	.					
Use Level	Organism	Q _a	O _b	O _A	O _B	SI
0.05% #	SA	200	1600	0.5	499.5	0.31
**	ECOLI	100	1600	0.5	499.5	0.32
**	PSA	1200	1600	0.5	499.5	0.31
n	PC	1800	1250	0.5	499.5	0.40
"	CAN	100	15000	0.5	499.5	0.04
•	AN	100	3200	0.5	499.5	0.16
<u>Use Level</u>	Organism	O _{a_}	O _b	Q _N		CT
0.10%	SA	200	1600	——⊻A—— 1	O _B	SI
10	ECOLI	100	1600	1		0.63
Ħ	PSA	1200	1600	1	999	0.63
11	PC	1800			999	0.63
11	CAN		1250	1	999	0.80
11	AN	100	15000	1	999	0.08
••	MM	100	3200	1	999	0.32

TABLE 2 (CONT)

Use Level	Organism	Q	<u> </u>	O _A	O _B	sı
0.20%	SA	200	1600	2	1998	1.26
**	ECOLI	100	1600	2	1998	1.27
*1	PSA	1200	1600	2	1998	1.25
••	PC	1800	1250	2	1998	1.60
91	CAN	100	15000	2	1998	0.15
**	AN	100	3200	2	1998	0.64
					•	
<u>Use Level</u>	Organism	Oa	O _b	Q _A	O _B	sı
0.40%	SA	200	1600	4	3996	2.52
23	ECOLI	100	1600	- 4	3996	2.54
	PSA	1200	1600	4	3996	2.50
**	PC	1800	1250	4	3996	3.20
10	CAN	100	15000	4	3996	0.31
m	AN	100	3200	4	3996	1.29
	Organism	O _a	O _b	O _A	OB	SI
0.50%	SA	200	1600	5	4995	3.15
91	ECOLI	100	1600	5	4995	3.17
19	PSA	1200	1600	5	4995	3.13
Ħ	PC	1800	1250	. 5	4995	4.00
n	CAN	100	15000	5	4995	0.38
n	AN	100	3200	5	4995	1.61

TABLE 10
500:1 Wt. Ratio GERMALL® II/IPBC

<u>Use Level</u>	Organism	O _a	O _b	O _A	O _B	si
0.01%	SA	200	1600	0.2	99.8	0.06
11	ECOLI	100	1600	0.2	99.8	0.06
81	PSA	1200	1600	0.2	99.8	0.06
12	PC	1800	1250	0.2	99.8	0.08
89	CAN	100	15000	0.2	99.8	0.01
17	AN	100	3200	0.2	99.8	0.03
					•	
<u>Use Level</u>	Organism	O _a .	O _b	O _A	O _B	SI
0.025%	SA	200	1600	0.5	249.5	0.16
99	ECOLI	100	1600	0.5	249.5	0.16
••	PSA	1200	1600	0.5	249.5	0.16
949	PC	1800	1250	0.5	249.5	0.20
99	CAN	100	15000	0.5	249.5	0.02
**	AN	100	3200	0.5	249.5	0.08
<u>Use Level</u>	Organism	Oa	O _b	O _A	O _B	sı
0.05%	SA	200	1600	1	499	0.32
**	ECOLI	100	1600	1	499	0.32
**	PSA	1200	1600	1	499	0.31
97	PC	1800	1250	1	499	0.40
97	CAN	100	15000	1	499	0.04
tt	AN	100	3200	1	499	0.17
	Organism	Q _a _	Q _b	O _A	O _B	SI
0.10%	SA	200	1600	2	998	0.63
W	ECOLI	100	1600	2	998	0.64
**	PSA	1200	1600	2	998	0.63
17	PC	1800	1250	2	998	0.80
11	CAN	100	15000	2	998	0.09
97	AN	100	3200	2	998	0.33

TABLE 3 (CONT)

Use Leve	l Organism	0	O _b	0,	O _B	si
0.20%	SA	200	1600	4	1996	1.27
11	ECOLI	100	1600	· 4	1996	1.29
11	PSA	1200	1600	4	1996	1.25
99	PC	1800	1250	4	1996	1.60
H	CAN	100	15000	4	1996	0.17
H	AN	100	3200	4	1996	0.66
Use Level	Organism	Q _a	<u>o</u>	O _A	O _n _	SI
0.40%	SA	200	1600	8	3992	2.54
117	ECOLI	100	1600	8	3992	2.58
**	PSA	1200	1600	8	3992	2.50
bi	PC	1800	1250	8	3992	3.20
**	CAN	100	15000	8	3992	0.35
**	AN	100	3200	. 8	3992	1.33
	4.4					
Use Level	Organism	Q _a _	O _h	O _N	Q _B	SI
0.50%	SA	200	1600	10	4990	3.17
99	ECOLI	100	1600	10	4990	3.22
91	PSA	1200	1600	10	4990	3.13
11	PC	1800	1250	10	4990	4.00
99	CAN	100	15000	10	4990	0.43
n	AN	100	3200	10	4990	1.66

TABLE 4
200:1 Wt. Ratio GERMALL II/IPBC

Use Level	Organism	<u> </u>	O _b	O _A	O _B	<u>sı</u>
0.01%	SA	200	1600	0.5	99.5	0.06
91	ECOLI	100	1600	0.5	99.5	0.07
••	PSA	1200	1600	0.5	99.5	0.06
21	PC	1800	1250	0.5	99.5	0.08
**	CAN	100	15000	0.5	99.5	0.01
98	AN	100	3200	0.5	99.5	0.04
<u>Use Level</u>	Organism	Oa	O _b	O _A	O _B	SI
0.025%	SA	200	1600	1.25	248.75	0.16
81	ECOLI	100	1600	1.25	248.75	0.17
	PSA	1200	1600	1.25	248.75	0.16
11	PC	1800	1250	1.25	248.75	0.20
**	CAN	100	15000	1.25	248.75	0.03
**	AN	100	3200	1.25	248.75	0.09
	Organism	Q _a .	Q _b	Q _A	Q _B	SI
0.05%	SA	200	1600	2.5	497.5	0.32
Ħ	ECOLI	1.00	1600	2.5	497.5	0.34
•	PSA	1200	1600	2.5	497.5	0.31
H	PC	1800	1250	2.5	497.5	0.40
99	CAN	100	15000	2.5	497.5	0.06
**	AN	100	3200	2.5	497.5	0.18
		,		•		
Use Level	Organism	o _a _	O _b	O _A	O_B	SI
0.10%	SA	200	1600	5	995	0.65
11	ECOLI	100	1600	5	995	0.67
99	PSA	1200	1600	5	995	0.63
n	PC	1800	1250	5	995	0.80
es .	CAN	100	15000	5	995	0.12
88	AN	100	3200	5	995	0.36

TABLE 4 (CONT)

<u>Use Level</u>	Organism	O _a	O _b	O _A	O _B	si
0.20%	SA	200	1600	10	1990	1.29
91	ECOLI	100	1600	10	1990	1.34
B#	PSA	1200	1600	10	1990	1.25
Ħ	PC	1800	1250	10	1990	1.60
98	CAN	100	15000	10	1990	0.23
**	AN	100	3200	10	1990	0.72

Use Level	Organism	O _a _	O _b	O _A	O _B	si
0.40%	SA	200	1600	20	3980	2.59
11	ECOLI	100	1600	20	3980	2.69
99	PSA	1200	1600	20	3980	2.50
**	PC	1800	1250	20	3980	3.20
99	CAN	100	15000	20	3980	0.47
61	AN	100	3200	20	3980	1.44

<u>Use Level</u>	Organism	Q _a	Q _b	O _A	O _B	SI	
0.50%	SA	200	1600	25	4975	3.23	_
н	ECOLI	100	1600	25	4975	3.36	
Ħ	PSA	1200	1600	25	4975	3.13	
n	PC	1800	1250	25	4975	3.99	
11	CAN	100	15000	25	4975	0.58	
tt .	AN	100	3200	25	4975	1.80	

TABLE 5

100:1 Wt. Ratio GERMALL II/IPBC

Use Leve	l Organism	0	Q _b	O _{>}	O _B	SI
0.01%	SA	200	1600	1	99	0.07
**	ECOLI	100	1600	1	99	0.07
71	PSA	1200	1600	1	99	0.06
**	PC	1800	1250	1	99	0.08
**	CAN	100	15000	1	99	0.02
66	an	100	3200	1	99	0.04
<u>Use Level</u>	Organism	0	•	•		
0.025%	SA	O _a		O _A _	O _B _	SI
**	ECOLI	200	1600	2.5	248	0.17
**	PSA	100	1600.	2.5	248	0.18
**	PC	1200 1800	1600	2.5	248	0.16
81	CAN	100	1250 15000	2.5	248	0.20
**	AN .	100		2.5	248	0.04
		100	3200	2.5	248	0.10
Use Level	Organism	Q _a _	O _b	O _b	O _B	si
0.05%	SA	200	1600	5	495	0.33
99	ECOLI	100	1600	5	495	0.36
**	PSA	1200	1600	5	495	0.31
**	PC	1800	1250	5	495	0.40
**	CAN	100	15000	5	495	0.08
**	AN	100	3200	5	495	0.20
					•	
Use Level	Organism	O _a _	O _b	QA	Q _B	sı
0.10%	SA	200	1600	10	990	0.67
39	ECOLI	100	1600	10	990	0.72
99	PSA	1200	1600	10	990	0.63
n	PC	1800	1250	10	990	0.80
H.	CAN	100	15000	10	990	0.17
11	AN	100	3200	10	990	0.41

TABLE 5 (CONT)

<u>Use Level</u>	Organism	<u>O</u> a	O _b	O _n	Qn	sı
0.20%	SA	200	1600	20	1980	1.34
11	ECOLI	100	1600	20	1980	1.44
*1	PSA	1200	1600	20	1980	1.25
	PC	1800	1250	20	1980	1.60
**	CAN	100	15000	20	1980	0.33
99	AN	100	3200	20	1980	0.82

<u>Use Level</u>	Organism	O _a .	<u>Q</u> p	O ₂	O _B	sı
0.40%	SA	200	1600	40	3960	2.68
67	ECOLI	100	1600	40	3960	2.88
н	PSA .	1200	1600	40	3960	2.51
77	PC	1800	1250	40	3960	3.19
97	CAN	100	15000	40	3960	0.66
••	AN	100	3200	40	3960	1.64

<u>Use Level</u>	Organism	O _a	O _{>}	O ₂	O _B	sı
0.50%	SA	200	1600	50	4950	3.34
91	ECOLI	100	1600	50	4950	3.59
99	PSA	1200	1600	50	4950	3.14
13	PC	1800	1250	50 (4950	3.99
17	CAN	100	15000	50	4950	0.83
91	NA	100	3200	50	4950	2.05

TABLE 6
50:1 Wt. Ratio GERMALL® II/IPBC

<u>Use Level</u>	Organism	0,	O _b	O _A	O _B _	si
0.01%	SA	200	1600	2	98	0.07
**	ECOLI	100	1600	2	98	0.08
Ħ	PSA	1200	1600	2	98	0.06
17	PC	1800	1250	2	98	0.08
P4	CAN	100	15000	2	98	0.03
**	AN ,	100	3200	2	98	0.05
<u>Use Level</u>	Organism	O _a	0 _b	O _A	O _B _	sı
0.025%	SA	200	1600	5	245	0.18
**	ECOLI	100	1600	5	245	0.20
71	PSA	1200	1600	5	245	0.16
99	PC	1800	1250	5	245	0.20
n	CAN	100	15000	5	245	0.07
**	AN	100	3200	5	245	0.13
	_					
Use Level	Organism	Q _a	O _b	O _A	O _B	si
0.05%	SA _.	200	1600	10	490	0.36
91 99	ECOLI	100	1600	10	490	0.41
•• ••	PSA	1200	1600	10	490	0.31
	PC	1800	1250	10	490	0.40
	CAN	100	15000	10	490	0.13
Ħ	AN	100	3200	10	490	0.25
Hee Tanal	O	_				
	Organism	Oa_	O _b	O _A	O _B	SI
0.10% #	SA	200	1600	20	980	0.71
er er	ECOLI	100	1600	20	980	0.81
	PSA	1200	1600	20	980	0.63
11	PC	1800	1250	20	980	0.80
11	CAN	100	15000	20	980	0.27
88	AN	100	3200	20	980	0.51

TABLE 6 (CONT)

<u>Use Level</u>	Organism	Oa	O _b	O _A	O _B	SI
0.20%	SA	200	1600	40	1960	1.43
**	ECOLI	100	1600	. 40	1960	1.63
9)	PSA	1200	1600	40	1960	1.26
Ħ	PC	1800	1250	40	1960	1.59
11	CAN	100	15000	40	1960	0.53
97	AN	100	3200	40	1960	1.01

Use Level	Organism	Q _a	O _b	Q _A	O _B	sı
0.40%	SA	200	1600	80	3920	2.85
11	ECOLI	100	1600	80	3920	3.25
91	PSA	1200	1600	80	3920	2.52
**	PC	1800	1250	80	3920	3.18
m	CAN	100	15000	80	3920	1.06
Ħ	, MA	100	3200	80	3920	2.03

<u>Use Level</u>	Organism	Q _a	Q _b	O _A	Q _R	SI
0.50%	SA	200	1600	100	4900	3.56
99	ECOLI	100	1600	100	4900	4.06
**	PSA	1200	1600	100	4900	3.15
**	PC	1800	1250	100	4990	3.98
**	CAN	100	15000	100	4900	1.33
99	AN	100	3200	100	4900	2.53

TABLE 7
20:1 Wt. Ratio GERMALL® II/IPBC

Use Level	Organism	<u>o</u> _	O _h	Q _h	O _D	sı	
0.01%	SA	200	1600	5	95	0.08	
98	ECOLI	100	1600	5	95	0.11	
Pf	PSA	1200	1600	5	95	0.06	
91	PC	1800	1250	5	95	0.08	
58	CAN	100	15000	5	95	0.06	
89	AN	100	3200	5	95	0.08	
Use Level	Organism	Q _a	O _b	O _A	O _B	SI	
0.025%	SA	200	1600	12.5	237.5	0.21	
97	ECOLI	100	1600	12.5	237.5	0.27	
*	PSA	1200	1600	12.5	237.5	0.16	
11	PC	1800	1250	12.5	237.5	0.20	
Ħ	CAN	100	15000	12.5	237.5	0.14	
*1	AN	100	3200	12.5	237.5	0.20	
<u>Use Level</u>	0	•	_				
	<u>Organism</u> S A	O _a _	O _b	O _A	O _B	SI	
		200	1600	25	475	0.42	
	ECOLI	100	1600	25	475	0.55	
	PSA Do	1200	1600	25	475	0.32	
	PC	1800	1250	25	475	0.39	
	CAN	100	15000	25	475	0.28	
-	AN	100	3200	25	475	0.40	
<u>Use Level</u>	Organism	O _a _	<u>O</u> b	O _A	O _B	SI	
0.10%	SA	200	1600	50	950	0.84	-
••	ECOLI	100	1600	50	950	1.09	
					- 		
" 1	PSA	1200	1600	50	950	0.64	
•	PSA PC		1600 1250	50 50	950 950	0.64	
n]		1200 1800 100	1600 1250 15000	50 50 50	950 950 950	0.64 0.79 0.56	

TABLE 7 (CONT)

Organism	O _a .	O _b	O _A	O _B	SI
SA	200	1600	100	1900	1.69
ECOLI	100	1600	100	1900	2.19
PSA	1200	1600	100	1900	1.27
PC	1800	1250	100	1900	1.58
CAN	100	15000	100	1900	1.13
AN	100	3200	100	1900	1.59
Organism	O _a _	O _D	OA	O_B	SI
SA	200	1600	200	4800	4.00
ECOLI	100	1600	200	4800	5.00
PSA	1200	1600	200	4800	3.17
PC	1800	1250	200	4800	3.95
CAN	100	15000	200	4800	2.32
AN	100	3200	200	4800	3.50
		•	•	,	
			*•		
Organism	Q _{a_}	<u> </u>	Q _A _	O _B	SI
SA	200	1600	250	4750	4.22
ECOLI	100	1600	250	4750	5.47
PSA	1200	1600	250	4750	3.18
PC	1800	1250	250	4750	3.94
PC CAN	1800 100	1250 15000	250 250	4750 4750	3.94 2.82
	SA ECOLI PSA PC CAN AN Organism SA ECOLI PSA PC CAN AN Organism SA ECOLI	SA 200 ECOLI 100 PSA 1200 PC 1800 CAN 100 AN 100 Organism Qa ECOLI 100 PSA 1200 PC 1800 CAN 100 AN 100 SA 200 ECOLI 100 PSA 1200	SA 200 1600 ECOLI 100 1600 PSA 1200 1600 PC 1800 1250 CAN 100 15000 AN 100 3200 Organism Oa Ob SA 200 1600 PC 1800 1250 CAN 100 15000 AN 100 3200 Organism Oa Ob SA 200 1600 PC 1800 1250 CAN 100 3200 Organism Oa Ob SA 200 1600 ECOLI 100 1600 ECOLI 100 1600 PSA 1200 1600 ECOLI 100 1600 PSA 1200 1600	SA 200 1600 100 ECOLI 100 1600 100 PSA 1200 1600 100 PC 1800 1250 100 CAN 100 15000 100 AN 100 3200 100 Organism Qa Qb QA SA 200 1600 200 ECOLI 100 1600 200 PC 1800 1250 200 CAN 100 15000 200 AN 100 3200 200 AN 100 3200 200 Organism Qa Qb QA SA 200 1600 200 CAN 100 3200 200 AN 100 3200 200 Organism Qa Qb QA SA 200 1600 250 ECOLI 100 1600 250 ECOLI 100 1600 250 PSA 1200 1600 250	SA 200 1600 100 1900 ECOLI 100 1600 100 1900 PSA 1200 1600 100 1900 PC 1800 1250 100 1900 CAN 100 15000 100 1900 AN 100 3200 100 1900 Organism Q _a Q _b Q _A Q _B SA 200 1600 200 4800 PSA 1200 1600 200 4800 PSA 1200 1600 200 4800 PC 1800 1250 200 4800 PC 1800 1250 200 4800 CAN 100 15000 200 4800 AN 100 3200 200 4800 Organism Q _a Q _b Q _A Q _B SA 200 1600 250 4750 ECOLI 100 1600 250 4750 PSA 1200 1600 250 4750

999.5

0.07

TABLE 8
2000:1 Wt. Ratio DMDMH/IPBC

			•		***.*		
<u>Use Level</u>	Organi	sm		_O _b	_O _A	O _B	SI
0.01%	SA		200	1600	0.05	99.95	0.06
**	ECOL	ľ	100	800	0.05	99.95	0.13
91	PSA		1200	1600	0.05	99.95	0.06
27	PC		1800	1600	0.05	99.95	0.06
DT	CAN		100	16000	0.05	99.95	0.01
H	AN		100	16000	0.05	99.95	0.01
Use Level	Organism	O _R _	<u> </u>	Q _b		O _B	sı
0.025%	SA	200	1600	****	25 2	49.88	0.16
Ħ	ECOLI	100	800			49.88	0.31
*	PSA	1200	1600		•	49.88	0.16
91	PC	1800	1600		25 2	49.88	0.16
	CAN	100	16000	0.13	25 2	49.88	0.02
11	AN	100	16000			49.88	0.02
	1.			•			
Use Level	Organism	O _a _	O _b	OA		O _B	si
0.05%	SA	200	1600		5 4	99.75	0.31
n	ECOLI	100	800	0.25	5 4	99.75	0.63
11	PSA	1200	1600	0.2	5 4	99.75	0.31
"	PC	1800	1600	0.29	5 4	99.75	0.31
11	CAN	100	16000	0.2	5 4	99.75	0.03
	AN	100	16000	0.25	5 4	99.75	0.03
	•			,			•
<u>Use Level</u>	Organis	n (Ω _a	О _р	O _A	_Q _B	SI
0.10%	SA	2	200 1	.600	0.5	999.5	0.63
•	ECOLI	1	100	800	0.5	999.5	1.25
17	PSA	12	200 1	.600	0.5	999.5	0.63
n	PC	18	300 1	.600	0.5	999.5	0.62
11	CAN	1	100 16	000	0.5	999.5	0.07

100 16000

TABLE 8 (CONT)

Use Level	Organism	1 <u>Q</u>	O _b	O _A	O _B	sı
0.20%	SA	200	1600	1	1999	1.25
24	ECOLI	100	800	1	1999	2.51
57	PSA	1200	1600	1	1999	1.25
39	PC	1800	1600	. 1	1999	1.25
11	CAN	100	16000	1	1999	0.13
91	AN	100	16000	1	1999	0.13
					, ,	7.25
					•	
Use Level	Organism	O _a	<u> </u>	Q _A	Q _B	sı
0.40%	SA	200	1600	2	3998	2.51
**	ECOLI	100	800	2	3998	5.02
\$17	PSA	1200	1600	2	3998	2.50
н	PC	1800	1600	2	3998	2.50
Ħ	CAN	100	16000	2	3998	0.27
11	AN	100	16000	2	3998	0.27
					•	
<u>Use Level</u>	Organism	O	O _D	O _A	O _R	SI
0.50%	SA	200	1600	2.5	4997.5	3.14
11	ECOLI	100	800	2.5	4997.5	6.27
P2	PSA	1200	1600	2.5	4997.5	3.13
¥	PC	1800	1600	2.5	4997.5	3.12
11	CAN	100	16000	2.5	4997.5	0.34
Ħ	AN	100	16000	2.5	4997.5	0.34

TABLE 9
1000:1 Wt. Ratio DMDMH/IPBC

<u>Use Level</u>	Organism	O _a	Q _b	O _A	O _B	SI
0.01%	SA	200	1600	0.1	99.9	0.06
97	ECOLI	100	800	0.1	99.9	0.13
*1	PSA	1200	1600	0.1	99.9	0.06
Ħ	PC	1800	1600	0.1	99.9	0.06
**	CAN	100	16000	0.1	99.9	0.01
**	AN	100	16000	0.1	99.9	0.01
Use Level	Organism	O _a	O _b	O _A	O _B	SI_
0.025%	SA	200	1600	0.25	249.8	0.16
94	ECOLI	100	800	0.25	249.8	0.31
99	PSA	1200	1600	0.25	249.8	0.16
n	PC	, 1800	1600	0.25	249.8	0.16
##	CAN	100	16000	0.25	249.8	0.02
**	AN ;	100	16000	0.25	249.8	0.02
			* *** **			
					,	
Use Level	Organism	Q _a	Q b .	Q _A	O _R	SI
0.05%	SA	200	1600	0.5	499.5	0.31
Ħ	ECOLI	100	800	0.5	499.5	0.63
11	PSA	1200	1600	0.5	499.5	0.31
69	PC	1800	1600	0.5	499.5	0.31
	CAN	100	16000	0.5	499.5	0.04
98	AN	100	16000	0.5	499.5	0.04
	٠.					
Use Level	Organism	O _a	Q _b	O _A	O _B	sī
0.10%	SA	200	1600	1	999	0.63
	ECOLI	100	800	1	999	1.26
	PSA	1200	1600	1	999	0.63
69	PC	1800	1600	1	999	0.62
99	CAN	100	16000	1	999	0.07
tf	AN	100	16000	1	999	0.07

TABLE 9 (CONT)

<u>Use Level</u>	Organism	O _a	O _b	<u> </u>	O _R	SI
0.20%	SA	200	1600	2	1998	1.26
97	ECOLI	100	800	2	1998	2.52
59	PSA	1200	1600	2	1998	1.25
91	PC	1800	1600	2	1998	1.25
**	CAN	100	16000	2	1998	0.14
11	AN	100	16000	2	1998	0.14

Use Level	Organism	Q _a _	Q _b	O _A	O _B	sı
0.40%	SA	200	1600	4	3996	2.52
н	ECOLI	100	800	. 4	3996	5.04
w	PSA	1200	1600	4	3996	2.50
#	PC	1800	1600	4	3996	2.50
**	CAN	100	16000	4	3996	0.29
98	AN	100	16000	4	3996	0.29

<u>Use Level</u>	Organism	Q _a	O _b	O _b	O _D	SI
0.50%	SA	200	1600	5	4995	3.15
M	ECOLI	100	800	5	4995	6.29
· 99	PSA ·	1200	1600	5	4995	3.13
11	PC	1800	1600	5	4995	3.12
**	CAN	100	16000	5	4995	0.36
97	AN	100	16000	2.5	4997.5	0.36

0.08

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998

998

TABLE 10 500:1 Wt. Ratio DMDMH/IPBC

	•					
Use Level	Organism	Oa.	Q _b	O _A	O _B	SI
0.01%	SA	200	1600	0.2	99.8	0.06
**	ECOLI	100	800	0.2	99.8	0.13
	PSA	1200	1600	0.2	99.8	0.06
•	PC	1800	1600	0.2	99.8	0.06
81	CAN	100	16000	0.2	99.8	0.01
Ħ	AN	100	16000	0.2	99.8	0.01
Use Level	Organism	O _a	Q _b	O _A	O _B	SI
0.25%	SA	200	1600	0.5	249.5	0.16
19	ECOLI	100	800	0.5	249.5	0.32
11	PSA	1200	1600	0.5	249.5	0.16
**	PC	1800	1600	0.5	249.5	0.16
Ħ	CAN	100	16000	0.5	249.5	0.02
**	AN	100	16000	0.5	249.5	0.02
Use Level	Organism	<u> </u>	Q _b	0	. Or	SI
0.05%	SA	200	1600		499	0.32
Ħ	ECOLI	100	800	1	499	0.63
99	PSA	1200	1600	1	499	0.31
*	PC	1800	1600	1	. 499	0.31
89	CAN	100	16000	1	499	0.04
•	AN	100	16000	1	499	0.04
	-	•			•	
Use Level	Organism	O _a _	<u>O</u> b_	Q _A	O _B	SI
0.10%	SA	200	1600	2	998	0.63
H	ECOLI	100	800	2	998	1.27
	PSA	1200	1600	2	998	0.63
11	PC	1800	1600	2	998	0.62
						·

CAN

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100

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16000

16000

TABLE 10 (CONT)

Use Level	Organism	O _a	<u>O</u> b	O _A	O _B	SI
0.20%	SA	200	1600	4	1996	1.27
••	ECOLI	100	800	4	1996	2.54
11	PSA	1200	1600	4	1996	1.25
**	PC	1800	1600	4	1996	1.25
11	CAN	100	16000	4	1996	0.16
H	AN	100	16000	4	1996	0.16

Use Level	Organism	O _a _	O _b	O _A	O _B	SI	_
0.40%	SA	200	1600	. 8	3992	2.54	
99	ECOLI	100	800	8	3992	5.07	
10	PSA	1200	1600	8	3992	2.50	
10	PC	1800	1600	8 .,	3992	2.50	
**	CAN	100	16000	8	3992	0.33	
81	ИА	100	16000	8 ,	3992	0.33	

Use Level	Organism	Q _a .	O _b	Q _A _	O _B	si	_
0.50%	SA	200	1600	10	4900	3.11	
11	ECOLI	100	800	10	4900	6.23	
21	PSA	1200	1600	10	4900	3.07	
H	PC	1800	1600	10	4900	3.07	
19	CAN	100	16000	10	4900	0.41	
••	AN	100	16000	10	4900	0.41	

TABLE 11
200:1 Wt. Ratio DMDMH/IPBC

<u>Use Level</u>	Organism	Q _a _	Q _b	Q _A	Q _R	sı
0.01%	SA	200	1600	0.5	99.5	0.06
**	ECOLI	100	800	0.5	99.5	0.13
**	PSA	1200	1600	0.5	99.5	0.06
89	PC	1800	1600	0.5	99.5	0.06
11	CAN	100	16000	0.5	99.5	0.01
н	AN	100	16000	0.5	99.5	0.01
Use Level	Organism	Q _a _	<u>Q</u> b	O _A	O _B	SI
0.025%	SA	200	1600	1.25	248.75	0.16
99	ECOLI	100	800	1.25	248.75	0.32
**	PSA	1200	1600	1,25	248.75	0.16
	PC	1800	1600	1.25	248.75	0.16
**	CAN	100	16000	1.25	248.75	0.03
n	AN	100	16000	1.25	248.75	0.03
	ECOLI 100 800 0.5 99.5 0.13 PSA 1200 1600 0.5 99.5 0.06 PC 1800 1600 0.5 99.5 0.06 CAN 100 16000 0.5 99.5 0.01 AN 100 16000 0.5 99.5 0.01 AN 100 16000 0.5 99.5 0.01 ELEVEL Organism Qa Qb Qa QB SI ECOLI 100 800 1.25 248.75 0.16 ECOLI 100 800 1.25 248.75 0.16 PC 1800 1600 1.25 248.75 0.16 CAN 100 16000 1.25 248.75 0.03 AN 100 16000 1.25 248.75 0.03 AN 100 16000 1.25 248.75 0.03 ECOLI 100 800 2.5 497.5 0.03 ECOLI 100 800 2.5 497.5 0.31 PC 1800 1600 2.5 497.5 0.31 PC 1800 1600 2.5 497.5 0.31 CAN 100 16000 2.5 497.5 0.31 CAN 100 16000 2.5 497.5 0.06 AN 100 16000 2.5 497.5 0.06 AN 100 16000 2.5 497.5 0.06 Level Organism Qa Qb Qa QB SI Level Organism Oa Qa Qb Qa QB SI Level Organism Oa Qa Qb Qa QB SI					
					,	
Use Level	Organism	O _a _	<u>O</u> b	O _A	O _B	SI
Use Level 0.05%		_				
	SA	200	1600	2.5	497.5	0.32
0.05%	SA ECOLI	200 100	1600 800	2.5 2.5	497.5 497.5	0.32
0.05% H	SA ECOLI PSA	200 100 1200	1600 800 1600	2.5 2.5 2.5	497.5 497.5 497.5	0.32 0.65 0.31
0.05% H	SA ECOLI PSA PC	200 100 1200 1800	1600 800 1600 1600	2.5 2.5 2.5 2.5	497.5 497.5 497.5 497.5	0.32 0.65 0.31 0.31
0.05% H H	SA ECOLI PSA PC CAN	200 100 1200 1800 100	1600 800 1600 1600	2.5 2.5 2.5 2.5 2.5	497.5 497.5 497.5 497.5	0.32 0.65 0.31 0.31
0.05% и п п	SA ECOLI PSA PC CAN	200 100 1200 1800 100	1600 800 1600 1600	2.5 2.5 2.5 2.5 2.5 2.5	497.5 497.5 497.5 497.5	0.32 0.65 0.31 0.31
0.05% n n n s	SA ECOLI PSA PC CAN AN	200 100 1200 1800 100	1600 800 1600 1600 16000	2.5 2.5 2.5 2.5 2.5 2.5	497.5 497.5 497.5 497.5 497.5	0.32 0.65 0.31 0.31 0.06 0.06
0.05% n n s Use Level 0.10%	SA ECOLI PSA PC CAN AN Organism	200 100 1200 1800 100	1600 800 1600 16000 16000	2.5 2.5 2.5 2.5 2.5 2.5	497.5 497.5 497.5 497.5 497.5 497.5	0.32 0.65 0.31 0.31 0.06 0.06
0.05% n n n s	SA ECOLI PSA PC CAN AN Organism SA	200 100 1200 1800 100 100	1600 800 1600 16000 16000	2.5 2.5 2.5 2.5 2.5 2.5 2.5	497.5 497.5 497.5 497.5 497.5 497.5	0.32 0.65 0.31 0.31 0.06 0.06
0.05% n n s Use Level 0.10%	SA ECOLI PSA PC CAN AN Organism SA ECOLI	200 100 1200 1800 100 100	1600 800 1600 16000 16000 0 0 16000 800	2.5 2.5 2.5 2.5 2.5 2.5 5	497.5 497.5 497.5 497.5 497.5 497.5 995	0.32 0.65 0.31 0.06 0.06 SI 0.65 1.29
0.05% n n s Use Level 0.10%	SA ECOLI PSA PC CAN AN Organism SA ECOLI PSA	200 100 1200 1800 100 200 100	1600 800 1600 16000 16000 2 ₀ 1600 800 1600	2.5 2.5 2.5 2.5 2.5 2.5 5 5	497.5 497.5 497.5 497.5 497.5 497.5 995	0.32 0.65 0.31 0.06 0.06 SI 0.65 1.29 0.63
0.05% и п п п п п п п п п п п п п п п п п п	SA ECOLI PSA PC CAN AN Organism SA ECOLI PSA PC	200 100 1200 1800 100 100 200 100 1200 1800	1600 800 1600 16000 16000 1600 800 1600	2.5 2.5 2.5 2.5 2.5 2.5 5 5	497.5 497.5 497.5 497.5 497.5 497.5 995 995 995	0.32 0.65 0.31 0.06 0.06 SI 0.65 1.29 0.63 0.62

TABLE 11 (CONT)

Use Level	Organism	Q _a	O _b	O _A	Q _B	SI
0.20%	SA	200	1600	10	1990	1.29
99	ECOLI	100	800	10	1990	2.59
**	PSA	1200	1600	10	·1990	1.25
29	PC	1800	1600	10	1990	1.25
91	CAN	100	16000	10	1990	0.22
94	AN	100	16000	10	1990	0.22

Use Level	Organism	Q _a	Q _b	O _A	O _R	sı
0.40%	SA	200	1600	20	3980	2.59
n	ECOLI	100	800	20	3980	5.18
**	PSA	1200	1600	20	3980	2.50
91	PC	1800	1600	20	3980	2.50
62	CAN	100	16000	20	3980	0.45
11	AN	100	16000	20	3980	0.45

<u>Use Level</u>	Organism	O _a _	Q _b	Q _A	O _B	SI
0.50%	SA	200	1600	25	4975	3.23
13	ECOLI	100	800	25	4975	6.47
89	PSA	1200	1600	25	4975	3.13
••	PC	1800	1600	25	4975	3.12
99	CAN	100	16000	25	4975	0.56
	AN	100	16000	25	4975	0.56

TABLE 12
100:1 Wt. Ratio DMDMH/IPBC

Use Level	Organism	Q <u>a</u>	O _b	O _A	O _B	<u>si</u>
0.01%	SA	200	1600	1	99	0.07
**	ECOLI	100	800	1	99	0.13
**	PSA	1200	1600	1	99	0.06
ti	PC	1800	1600	1	99 ·	0.06
H	CAN	100	16000	1	99	0.02
11	AN	100	16000	1	99	0.02
<u>Use Level</u>	Organism	O _a _	O _b	O _A	O _B	SI
0.025%	SA	200	1600	2.5	248	0.17

DOE DEVEL	Ordalitain	V _a	<u></u>		<u> </u>	SI
0.025%	SA	200	1600	2.5	248	0.17
91	ECOLI	100	800	2.5	248	0.33
×	PSA	1200	1600	2.5	248	0.16
91	PC	1800	1600	2.5	248	0.16
99	CAN	100	16000	2.5	248	0.04
***	AN	100	16000	2.5	248	0.04

nse reset	Organism	Q _a _	Q _b	O _A	Q _B	SI	
0.05%	SA	200	1600	5	495	0.33	
**	ECOLI	100	800	5	495	0.67	
**	PSA	1200	1600	5	495	0.31	
81	PC	1800	1600	5 .	495	0.31	
**	CAN	100	16000	5	495	0.08	
**	AN	100	16000	5	495	0.08	

TABLE 12 (CONT)

Use Level	Organism	Oa	O _b	O _A	O _B	SI
0.10%	SA	200	1600	10	990	0.67
10	ECOLI	100	800	10	990	1.34
***	PSA	1200	1600	10	990	0.63
87	PC	1800	1600	10	990	0.62
81	CAN	100	16000	10	990	0.16
**	AN	100	16000	10	990	0.16
						•
<u>Use Level</u>	Organism	Q _a	Q _b	Q _A	Q _B	SI
0.20%	SA	200	1600	20	1980	1.34
**	ECOLI	100	800	20	1980	2.68
91	PSA	1200	1600	, 20	1980	1.25
71	PC	1800	1600	20	1980	1.25
**	CAN	100	16000	20	1980	0.32
61	AN ·	100	16000	20	1980	0.32
Use Level	Organism	O _a .	o _b	O _A	O _B	SI
0.40%	SA	500	1600	40	3960	2.68
87	ECOLI	100	800	40	3960	5.35
**	PSA	1200	1600	40	3960	2.51
•	PC	1800	1600	40	3960	2.50
**	CAN	100	16000	40	3960	0.65
10	AN	100	16000	40	3960	0.65
						,
		,				
Use Level	Organism	<u>Q</u> a	Q _b	Q _A	Q _B	SI
0.50%	SA	200	1600	50	4950	3.34
Ħ	ECOLI	100	800	50	4950	6.69
n	PSA	1200	1600	50	4950	3.14
₩	PC ·	1800	1600	50	4950	3.12
11	CAN	100	16000	50	4950	0.81
99	AN	100	16000	50	4950	0.81

TABLE 13
50:1 Wt. Ratio DMDMH/IPBC

•						
Use Level	Organism	<u>0</u> ,	Q _b	O _A	O _B	sı
0.01%	SA	200	1600	2	98	0.07
t 1	ECOLI	100	800	2	98	0.14
99	PSÁ	1200	1600	2	98	0.06
**	PC	1800	1600	2	98	0.06
**	CAN	100	16000	2	98	0.03
w	AN	100	16000	2	98	0.03
			•			
Use Level	Organism	O _a .	Q _b	O _A	O _R	SI
0.025%	SA	200	1600	5	245	0.18
11	ECOLI	100	800	5	245	0.36
11	PSA	1200	1600	5	245	0.16
99	PC	1800	1600	5	245	0.16
69	CAN	100	16000	5	245	0.07
11	AN	100	16,000	5	245	0.07
		-	•	•		
Use Level	Organism	Q _a _	<u> </u>	O _A	O _B	SI
0.05%	SA	200	1600	10	490	0.36
*	ECOLI	100	800	10	490	0.71
×	PSA	1200	1600	10	490	0.31
**	PC	1800	1600	10	490	0.31
**	CAN	100	16000	10	490	0.13

100

16000

10

490

0.13

TABLE 13 (CONT)

Use Level	Organism	0	<u>O</u> b	O _A	O _R	SI
0.10%	SA	200	1600	20	980	0.71
11	ECOLI	100	800	20	980	1.43
tt	PSA	1200	1600	20	980	0.63
91	PC	1800	1600	20	980	0.62
91	CAN	100	16000	20	980	0.26
88	AN	100	16000	20	980	0.26
Time Years	0	•	_	_		
Use Level 0.20%		O _a	_	O _A	O _B	SI
U.2U&	SA	200	1600	40	1960	1.43
## ##	ECOLI	100	800	40	1960	2.85
u	PSA	1200	1600	40	1960	1.26
n	PC	1800	1600	40	1960	1.25
"	CAN	100	16000	40	1960	0.52
••	AN	100	16000	40	1960	0.52
	,		. *	. •		
Use Level	Organism	0 _a	O _b	<u>Ö</u> ,	<u>О</u> в	sı
0.40%	SA	200	1600	80	3920	2.85
Ħ.	ECOLI	100	800	80	3920	5.70
•	PSA	1200	1600	80	3920	2.52
19	PC	1800	1600	80	3920	2.49
99	CAN	100	16000	80	3920	1.05
**	AN	100	16000	80	3920	1.05
	· .	. *				
Use Level	Organism	Oa_	Q _b	Q _A	Q _B	SI
0.50%	SA	200	1600	100	4900	3.56
**	ECOLI	100	800	100	4900	7.13
99	PSA	1200	1600	100	4900	3.15
61	PC	1800	1600	100	4900	3.12
**	CAN	100	16000	100	4900	1.31
67	ИА	100	16000	100	4900	1.31

TABLE 14
20:1 Wt. Ratio DMDMH/IPBC

Use Level	Organism	O	Q _b	O _A	O _B	sı
0.01%	SA	200	1600	5	95	0.08
#	ECOLI	100	800	5	95	0.17
81	PSA	1200	1600	5	95	0.06
89	PC	1800	1600	5	95	0.06
**	CAN	100	16000	5	95	0.06
**	AN	100	16000	5	95	0.06
					. **	
Use Level	Organism	O _a	O _b	OA	O _B	SI
0.025%	SA	200	1600	12.5	237.5	0.21
**	ECOLI	100		12.5	237.5	0.42
••	PSA	1200	1600	12.5	237.5	0.16
	PC	1800	1600	12.5	237.5	0.16
**	CAN	100	16000	12.5	237.5	0.14
**	AN	100	16000	12.5	237.5	0.14
Use Level	Organism	O _a	O _b	O _A	O _B	SI
0.05%	SA	200	1600	25	475	0.42
**	ECOLI	100	800	25	475	0.84
**	PSA	1200	1600	25	475	0.32
••	PC	1800	1600	25	475	0.31
**	CAN	100	16000	25	475	0.28
**	AN	100	16000	25	475	0.28
		•			-	
	•				•	
Use Level	Organism	Q _a _	O _b	Q _A	Q _B	SI
0.10%	SA	200	1600	50	950	0.84
37	ECOLI	100	800	50	950	1.69
H	PSA	1200	1600	50	950	0.64
11	PC	1800	1600	50	950	0.62
Ħ	CAN	100	16000	50	950	0.56
Ħ	AN	100	16000	50	950	0.56

TABLE 14 (CONT)

Use Level	Organism	Q _a	<u>Q</u> b	O _A	O _B	SI
0.20%	SA	200	1600	100	1900	1.69
**	ECOLI	100	800	100	1900	3.38
91	PSA	1200	1600	100	1900	1.27
**	PC	1800	1600	100	1900	1.24
99	CAN	100	16000	100	1900	1.12
••	AN	100	16000	100	1900	1.12
Use Level	Organism	O _a	O _b	O _A	O _B	sı
0.40%	SA	200	1600	200	4800	4.00
11	ECOLI	100	800	200	4800	8.00
•	PSA	1,200	1600	200	4800	3.17
94	PC	1800	1600	200	4800	3.11
99	CAN	100	16000	200	4800	2.30
99	AN	100	16000	200	4800	2.30
	•					
			•.	:::		
Use Level	Organism	Q _a _	O _b	O _A	O _B	sı
0.50%	SA	200	1600	250	4750	4.22
11	ECOLI	100	800	250	4750	8.44
m	PSA .	1200	1600	250	4750	3.18
*	PC	1800	1600	250	4750	3.11
Ħ	CAN	100	16000	250	4750	2.80
H	AN	100	16000	250	4750	2.80

Similar SI results also were found with GADM and SUTTOCIDE® A as the methylol compound in place of Germall® II or DMDMH in admixtures with IPBC over the same wt. ratios and use level ranges as shown in the Tables 1-14 above.

Tables 1 through 14 abov illustrate the synergism of IPBC (compound B) with Germall® II or DMDMH (compound A) at weight ratios of A:B of 2000:1, 1000:1, 500:1, 200:1, 100:1, 50:1 and 20:1. Synergism is very effective for all ratios at low use levels, e.g. 0.01% to 0.1%, against all tested gram-positive, gram-negative organisms and fungi organisms. At slightly higher use concentrations, e.g. 0.20 to 0.50%, all tested ratios were synergistic against Candida albicans and A. niger also. However, at 50:1 and 20:1 ratios, the synergistic effect is negligible at the 0.01 to 0.1% use levels, and non-synergistic even against Candida albicans and A. niger at use levels of 0.20 to 0.50%.

The SI values were lower for Germall® II as the methylol compound in the admixtures as compared to DMDMH.

Similar results were obtained when iodopropynyl alcohol (IPGA) was substituted for IPBC in the admixtures described above.

3. PRESERVATIVE ACTIVITY (CHALLENGE TEST)

A typical cosmetic emulsion was prepared for microbiological challenge testing and predetermined admixtures of a methylol compound and IPBC were added at various use levels. The emulsion thus prepared had the following composition:

Phase A	% wt.
Stearic Acid	5.00
Mineral Oil	2.50
Cetyl Alcohol	1.00
Lareth-5 and Ceteth-5 and	•
Oleth-5 and Steareth-5	0.50
Glycerol Monostearate and	
Polyoxyethylene Stearate	1.50

1.00

Phase B Deionized Water 88.0 Triethanolamine 99%

Citric Acid 30% aqueous solution 0.60

Preservative Admixture qs

To prepare the emulsion, Phases A and B were heated separately to 75-80°C. Phase A then was added to Phase B with mixing. The mixture then was cooled to 55-60°C. At this point the desired amount of the preservative admixture was added and the product was cooled to 50°C. while stirring. The citric acid solution then was added to adjust the pH and the mixture was stirred until a temperature of 30°C. was reached.

The challenge tests were carried out using the following microorganisms: SA, ECOLI, PSA, PC, AN and CAN, in this manner. 50 g. aliquots of the test emulsion containing various amounts of the preservative admixture were inoculated with approximately 107-108 of the challenge organisms. The test samples then were stirred to disperse the challenge inoculum. The samples were incubated and assayed at 48 hours, 7, 14, 21 and 28 days. The assays were performed on 1 g. of the test sample by serially diluting 101 to 106 of the original concentration. The plating medium for bacteria was Letheen agar and for fungi it was low pH Mycophil agar with Tween 20. Each plated sample was incubated for 48 hours at 37°C. for bacteria, 5 days at 25°C. for mold, and 3 days at 25°C. for fungi. After incubation, readings of the number of colonies per milliliter (cfu/ml) were made. At 21 days the test product was reinoculated with half of the original inoculum. data is presented in Tables 15-23 below.

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		28 Days	4,500	19,000	560,000	<10	<10	3,700	28 Days	220	110,000	<10	<10	<10	<10	 28 Days	<10	320	<10	<10	<10	<10
		21 Days	17,000	3,100	138,000	<10	<10	<10	21 Days	<10	26,000	<10	<10	<10	<10	21 Days	<10	<10	<10	<10	<10	<10
	I/IPBC	14 Days	190,000	1,400	2,400	<10	<10	<10	14 Days	10	18,000	<10	<10	<10	<10	14 Days	<10	70	<10	<10	<10	<10
TABLE 15	2000:1 GERMALL® II/IPBC	7 Days	260,000	76,000	290,000	<10	<10	220	7 Days	. 01	29,000	10	<10	<10	170	7 Days	<10	009'9	<10	<10	<10	<10
	2000:1	48 Hours	000'69	000'86	110,000	<10	<10	190,000	48 Hours	2,800	58,000	39,000	<10	<10	37,000	48 Hours	20	19,000	3,400	<10	<10	31,000
		Organism	AN	CAN	ECOLI	Dd	PSA	SA	Organism	AN	CAN	ECOLI	PC	PSA	∴SA	Organism	AN	CAN	ECOLI	PC	PSA	SA
		Test Level	0.01%	=	=	•			Test Level	0.025\$	=	2	=	e- -	s ,	Test Level	0.05%	=	=	=	=	=

			TABLE 15 (CONT)	ส		
Test Level	Organism	48 Hours	7 Days	14 Days	21 Days	28 Days
0.18	AN	<10	<10	<10	<10	<10
=	CAN	180	<10	<10	<10	<10
=	ECOLI	<10	<10	<10	<10	<10
=	PC	<10	<10	<10	<10	<10
=	PSA	<10	<10	<10	<10	<10
E	SA	750	<10	<10	<10	<10
Test Level	Organism	48 Hours	7 Days	14 Days	21 Days	28 Days
0.2%	AN	<10:	<10	<10	<10	<10
	CAN	<10	<10	<10	<10	<10
E	ECOLI	<10	<10	<10	<10	<10
-	PC	<10	<10	<10	<10	<10
=	PSA	<10	<10	<10	<10	<10
:	SA	<10	<10 >	<10	<10	<10
Unpreserved control	ntrol					
Organism	48 Hours	7 Days	14 Days	21 Days	28 Days	S
AN	52,000	27,000	19,000	19,000		19,000
CAN	110,000	130,000	240,000	180,000		240,000
ECOLI	54,000	140,000	170,000	170,000		74,000
PC	6,400,000	6,400,000	2,000,000	6,700,000		29,000
PSA	110,000	700	110,000	290,000		85,000
SA	2,800,000	250,000	51,000	3,	3,700	330

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Inoculum Concentration	centration					
Organism	어	0 Hours	21 Days			
AN		26,000	53,000			
CAN	1,0	1,000,000	1,900,000			
ECOLI	3,6	3,600,000	170,000			
PC	3,4	3,400,000	87,000			
PSA	N. 4	4,500,000	390,000		٠	
SA	4,1	4,100,000	200,000		• **•	
·			TABLE 16		1 1	
		1000:1	1000:1 GERMALL® II/IPBC	I/IPBC	. :	
Test Level	Organism	48 Hours	7 Days	14 Days	21 Days	28 Days
0.01%	AN	34,000	3,500	80	10	<10
z	CAN	420,000	24,000	950	6,400	6,400,000
r	ECOLI	120,000	63,000	93,000	92,000	9,600,000
	PC	10	25,000	1,600	15,800	33,000,000
E	PSA	<10	<10	<10	<10	<10
=	SA	100,000	1,400	<10	<10	5,000

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Test Level	Organism	48 Hours	7 Days	14 Days	21 Days	28 Days
0.025%	AN	530	10	<10	<10	<10
=	CAN	34,000	750	10	770	240,000
=	ECOLI	120,000	<10	<10	<10	<10
E	PC	<10	<10	<10	<10	<10
	PSA	<10	<10	<10	<10	<10
. 22	SA	37,000	170	<10	<10	<10
		. `				
Test Level	Organism	48 Hours	7 Days	14 Days	21 Days	28 Days
0.05%	AN	<10	<10		<10	<10
=	CAN	13,000	<10		<10.	<10
=	ECOLI	68,000	<10	<10	<10	<10
	PC	<10	<10		<10.	<10
=	PSA	<10	<10		<10	<10
· .	SA	21,000	<10.		<10	<10
			•			er .
Test Level	Organism	48 Hours	7 Days	14 Days	21 Days	28 Days
0.18	- AN	<10	<10	<10	<10	<10
	CAN	10	<10	<10	<10	<10
=	ECOLI	<10	<10	<10	<10	<10
=	50	<10	<10	<10	<10	<10
=	PSA	<10	<10	<10	<10	<10
=	SA	1,400	<10	<10	<10	<10

TABLE 16 (CONT)

28 Days	<10	<10	<10	<10	<10	<10	•	15	:					4								
21 Days 2	<10	<10	<10	<10	<10	<10	•*	28 Days	19,000	240,000	74,000	29,000	85,000	330	• 9							
21								21 Days	19,000	180,000	170,000	6,700,000	290,000	3,700		٠.				•		
14 Days	<10	<10	<10	<10	<10	<10		21														
7 Days	<10	<10	<10	<10	<10	<10		14 Days	19,000	240,000	170,000	2,000,000	110,000	51,000		21 Days	53,000	1,900,000	170,000	87,000	390,000	200.000
48 Hours	<10	<10	<10	<10	<10	<10		7 Days	27,000	130,000	140,000	6,400,000	100	250,000		O Hours	26,000	1,000,000	3,600,000	3,400,000	4,500,000	4.100.000
Organism	AN	CAN	ECOLI	PC	PSA	SA	control	48 Hours	52,000	110,000	54,000	6,400,000	110,000	2,800,000	ncentration			1,0	3,(3,4	4,5	4
Test Level	0.2%	=	=	=	=	=	Unpreserved control	Organism	AN	CAN	ECOLI	PC	PSA	SA	Inoculum Concentration	Organism	AN	CAN	ECOLI	PC	PSA	SA

	28 Days	<10	<10	240,000	42,000,000	<10	5,100		28 Days	<10	<10	<10	<10	<10	<10		28 Days	<10	<10	<10	<10	<10	<10
	21 Days	<10	200	70,000	>10,000	<10	<10		21 Days	<10	<10	<10	<10	<10	<10		21 Days	<10	<10	<10	<10	<10	<10
II/IPBC	14 Days	<10	290	95,000	<10	<10	<10	1	14 Days	<10	<10	<10	<10	<10	<10		14 Days	<10	<10	<10	<10	<10	<10
TABLE 17 500:1 GERMALL® II/IPBC	7 Days	40	5,600	57,000	<10	<10	440		7 Days	<10	<10	<10	<10	<10	<10		7 Days	<10	<10	<10	<10	<10	<10
500	48 Hours	23,000	170,000	000'06	10	<10	380,000		48 Hours	<10	8,700	60,000	<10	<10	31,000		48 Hours	<10	<10	<10	<10	<10	068
	Organism	AN	CAN	ECOLI	PC	PSA	SA	•	Organism	AN	CAN	ECOLI	PC	PSA	SA	-	Organism	AN	CAN	ECOLI	PC	PSA	SA
	Test Level	0.01\$	=	=	=	=	E .		Test Level	0.05%	=	=	Ę		= .	¥ 400	Texe rever	0.1%	*	=	=		£

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(CONT)	
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TABLE	

Test Level	l <u>Organism</u>	48 Hours	7 Days	14 Days	21 Days	28 Days
0.2\$	AN	<10	<10	<10	<10	<10
=	CAN	<10	<10	<10	<10	<10
2	ECOLI	<10	<10	<10	<10	<10
=	PC	<10	<10	<10	<10	<10
=	PSA	<10	<10	<10	<10	<10
	SA	<10	<10	<10	<10.	<10
Unpreserved control	ed control				`j\$\$ -	
Organism	48 Hours	7 Days	14 Days	21 Days	28 Days	
AN	6,100	520,000	18,000	5,000		0
CAN	1,000,000	710,000	95,000	12,000		
ECOLI	7,100,000	6,200,000	610,000	350,000		
PC	14,600,000	160,000,000	3,600,000	2,720,000	6	:
PSA	20	006	130	4,100		0
SA	43,000,000	600,000	1,000	220		
Inoculum Concentr	Concentration				÷	
Organism	;	0 Hours	21 Days			. d
AN		19,000	4,700,000			
CAN		340,000	16,000,000			
ECOLI	m	3,900,000	1,480,000			-
PC	m	3,800,000	1,380,000			
PSA	6	9,200,000	730,000			
SA	4	4,800,000	360,000			

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		21 Days	<10	190,000	a S
	I/IPBC	14 Days	10	410,000	012
TABLE 18	200:1 GERMALL® II/IPBC	7 Days	320	450,000	7.600
	200:	48 Hours	47,000	810,000	220.000

		200	200:1 GERMALL® II/IPBC	I/IPBC		
Test Level	Organism	48 Hours	7 Days	14 Days	21 Days	28 Days
0.01\$	AN	47,000	320	10	<10	<10
E	CAN	810,000	450,000	410,000	190,000	63,000
£	ECOLI	220,000	7,600	<10	850	>1,000,000
2	PC	10,000	500,000	1,900,000	1,100,000	193,000
=	PSA	<10	<10	<10	<10	<10
*	SA	190,000	23,000	120	<10	<10
			•			
Test Level	Organism	48 Hours	7 Days	14 Days	21 Days	28 Days
0.05%	AN	<10	<10	<10	<10	<10
t	CAN	190	<10	<10	<10	<10
=	ECOLI	37,000	<10	<10	<10	<10
r	PC	<10	<10	<10 <	<10	<10
	PSA	<10	<10	<10	<10	<10
*	SA	19,000	. <10	<10	<10	<10
Test Level	Organism	48 Hours	7 Days	14 Days	21 Days	28 Days
0.1%	AN	<10	<10.	<10	<10	<10
	CAN	10	<10	<10	<10	<10
2	ECOLI	<10	<10	<10	<10	<10
	PC	<10	<10	<10	<10	<10
=	PSA	<10	<10	<10	<10	<10
E	SA	45,000	<10	<10	<10	<10

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T st Level	Organism	48 Hours	7 Days	14 Days	21 Days	28 Days
0.2%	AN	<10	<10	<10	<10	<10
; ;	CAN	<10	<10	<10	<10	<10
=	ECOLI	<10	<10	<10	<10	<10
=	ည္	<10	<10	<10	<10	<10
=	PSA	<10	<10	<10	<10	<10
, =	SA	<10	- <10	<10	<10	<10
Unpreserved control	control					
Organism	48 Hours	7 Days	14 Days	21 Days	28 Days	9
AN	89,000	32,000	. 22,000	16,000		16,000
CAN	210,000	670,000	430,000	590,000		640,000
ECOLI	640,000	360,000	410,000	000'066		68,000
	19,000,000	3,200,000	7,000,000	>10,000	00 2,760,000	000
PSA	80	9,400	200,000	>10,000		34,000
SA	9,300,000	190,000	11,000	.	580	120
Inoculum Concentration	ncentration					
Organism		O HOUTE	21 Days			
AN		41,000	32,000			
CAN		640	1,100,000			
ECOLI	5,	2,800,000	1,300,000			
PC		000,006	3,000,000			٠
PSA	1,	1,800,000	4,900,000			
SA	7,	7,200,000	2,000,000			

		28 Dave		017	120	000 008		9.200			28 Days	<10	<10	<10	<10		<10		28 Days	<10		7	017	017	<10
		21 Davs	V 10	5.600	<10	720.000				of Course	2 4 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7	01 2	<10	<10	<10	<10	<10		21 Days	<10	<10	<10	<10	<10	<10
	/IPBC	14 Days	<10	560	10	340,000	<10	<10		14 Davs		07	<10	<10	<10	<10	<10	×	14 Days	<10	<10	<10	<10	<10	<10
TABLE 19	50:1 GERMALL® II/IPBC	7 Days	40	7,700	710	74,000	<10	11,000		7 Davs	100		07>	<10.	<10	<10	<10	•	7 Days	<10	<10	<10	<10	<10	<10
	50:	48 Hours	4,100	310,000	170,000	7,400	<10	110,000	•	48 Hours	<10	010	017	150,000	<10	<10	35,000		48 Hours	<10	<10	510	<10	<10	3,000
		Organism	AN	CAN	ECOLI	PC	PSA	SA	. :	Organism	AN	CAN	100	ECOLL	PC	PSA	SA	1	WSTUBA 77	AN.	CAN	ECOLI	P C	PSA	SA
		Test Level	0.01%	=	=	=	=			Test Level	0.05%		=	=	: :	:	•	Test Lavel	16	* T :	: ;	:	: :	z ;	:

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Test_Level	Organism	48 Hours	7 Days	14 Days 2	21 Days 28	28 Days
0.28	AN	<10	<10	<10	<10	<10
=	CAN	<10	<10	<10	<10	<10
=	ECOLI	<10	<10	<10	<10	<10
*	PC	<10	<10	<10	<10	<10
=	PSA	<10	<10	<10	<10	<10
*	SA	<10	<10	<10	<10	<10
Unpreserved control	control					
Organism	48 Hours	7 Days	14 Days	21 Days	28 Days	
AN	89,000	32,000	22,000	16,000	16,000	
CAN	210,000	.670,000	430,000	290,000	640,000	
ECOLI	640,000	360,000	410,000	000'066	68,000	•
PC	19,000,000	3,200,000	7,000,000	>10,000	2,760,000	
PSA	80	9,400	200,000	>10,000	34,000	
· SA	6,300,000	190,000	11,000	580	120	
Inoculum Concentration	centration					
Organism		0 Hours	21 Days			
AN		41,000	32,000			
CAN		640	1,100,000			
ECOLI	ស	5,800,000	1,300,000			
PC		000,006	3,000,000			
PSA	T	1,800,000	4,900,000			
SA	7	7,200,000	2,000,000			

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		Č	TABLE 20	(1		
Test Level	Organism	48 Hours	ZO: A SERVINIUS 11/1EDC	14 Days	21 Days	28 Days
0.01%	AN	3,100	<10	<10	<10	<10
	CAN	75,000	220	<10	<10	2,400
	ECOLI	160,000	110	<10	<10	20
	PC	12,000	1,000,000	2,100,000	>1,000,000	730,000
	PSA	<10	<10	<10	<10 >	4,000
	SA	140,000	4,100	<10	<10	1,680
		;		•		
Tear Tear	Organism	48 Hours	7 Days	14 Days	21 Days	28 Days
0.05%	AN	<10	<10	<10	<10	<10
	CAN	<10	<10	<10	<10	<10
	ECOLI	16,000	<10	<10	<10	<10
	PC	<10.	<10	<10	<10	<10
	PSA	<10	<10		<10	<10
	SA	31,000	<10	<10	<10	<10
					•••	
Test Level	Organism	48 Hours	7 Days	14 Days	21 Days	28 Days
0.18	. AN	<10	<10	<10	<10	<10
	CAN	<10	<10	<10	<10	<10
	ECOLI	<10	<10	<10	<10	. <10
	PC	<10	<10	<10	<1.0	<10
	PSA	<10	<10	<10	<10	<10
	SA	6,800	<10	<10	<10	<10

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Test Level	Organism	48 Hours	7 Days	14 Days	21 Days	28 Days
0.2%	AN	<10	<10	<10	<10	<10
=	CAN	<10	<10	<10	<10	<10
=	ECOLI	<10	<10	<10	<10	<10
2	PC	<10	<10	<10	<10	<10
=	PSA	<10	<10	<10	<10	<10
=	SA	<10	<10	<10	<10.	<10
Unpreserved cont	control				्रदेश सम्मास्य स्थापन	
Organism	48 Hours	7 Days	14 Days	21 Days	28 Days	뾔
AN	89,000	32,000	22,000	16,000	16,	16,000
CAN	210,000	670,000	430,000	590,000	640,000	000
ECOLI	640,000	360,000	410,000	000'066	189	68,000
PC	19,000,000	3,200,000	7,000,000	>10,000	2,760,000	000
PSA	80	9,400	200,000	>10,000	34,	34,000
SA	6,300,000	190,000	11,000	580		120
Inoculum Concent	centration					
Organism		O Hours	21 Days			
AN		41,000	32,000		•	
CAN		640	1,100,000			
ECOLI	, c	5,800,000	1,300,000			
PC		000,006	3,000,000			
PSA	٦,	1,800,000	4,900,000			
SA	7,	7,200,000	2,000,000			

			TABLE 21			
			2000:1 DMDMH/IPBC	PBC		
Test Level	Organism	48 Hours	7 Days	14 Days	21 Days	28 Days
0.025%	AN	4,100	38,000	270	80	100
=	CAN	270,000	1,900,000	550,000	220,000	210,000
=	ECOLI	1,300,000	<10	<10	<10	3,000
=	PC	<10	<10	<10	<10	<10
= :	PSA	<10	<10	<10	<10	<10
=	SA	42,000	20	<10	<10	<10
						٠.
Test Level	Organism	48 Hours	7 Days	14 Days	21 Days	28 Days
0.05%	AN	<10	<10	<10	<10	<10
	CAN	770,000	130,000	670,000	160,000	64,000
=	ECOLI	220,000	<10	<10	<10	<10
	PC D4	<10	<10	<10	<10	<10
=	PSA	<10	<10	<10	<10	<10
=	SA	000'6	<10	<10	<10	<10
Test Level	Organism	48 Hours	7 Days	14 Days	21_Days	28 Days
0.1\$	AN	<10	. <10	<10	<10	<10
=	CAN	580	840	200	40,000	83,000
2	ECOLI	340	<10	<10	. <10	<10
2	PC 24	<10	. <10	<10	<10	<10
=	PSA	<10	<10	<10	<10	<10
E	SA	29,000	<10	<10	<10	<10

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28 Days	<10	21	<10	<10	<10	<10			i jir													
21 Days 28	<10	<10	<10	<10	<10	<10	.:	28 Days	000'9	790,000	140,000	31,000,000	300,000	F. 110		.:						
14 Days 21	<10	10	<10	<10	<10	<10		21 Days	2,200	480,000	240,000	8,500,000	15,200	3,000								
7 Days 1	<10	10	<10	<10	<10	<10.	•	14 Days	24,000	3,300,000	7,300,000	5,900,000	100	12,000		21 Days	41,000	640	5,800,000	000'006	000'000'6	7,200,000
48 Hours	<10	<10	<10	<10	<10	<10		7_Days	36,000	1,900,000	2,500,000	15,600,000	<10	>1,000,000		0 Hours	20,000	1,400,000	4,800,000	9,200,000	6,900,000	5,700,000
Organism	AN	CAN	ECOLI	PC	PSA	SA	control	48 Hours	37,000	120,000	150,000	19,000,000	<10	7,000,000	oncentration			, r	4	6	6,	5,
Test Level	0.2%	=	*	=	•	=	Unpreserved control	Organism	AN	CAN	ECOLI	PC	PSA	SA	Ineculum Concenti	Organism	AN	CAN	ECOLI	PC	PSA	SA

Test level Organism 48 Hours 1 Davis 14 Davis 15 O.000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,000 120,00				TABLE 22			
evel Organism 48 Hours 7 Days 14 Days 21 Days AN 650 900 <10 <10 CAN 97,000 900,000 2,300,000 120,000 ECOLI 160,000 <10 <10 <10 PC <10 <10 <10 <10 PC <10 <10 <10 <10 SA 23,000 <10 <10 <10 AN 20 <10 <10 <10 CAN 65,000 520,000 56,000 32,000 PC <10 <10 <10 <10				1000:1 DMDMH/	IPBC		
AN 650 900 <10	Level	Organism	48 Hours	7 Days	14 Days	21 Days	28 Days
CAN 97,000 900,000 2,300,000 120,000 ECOLI 160,000 <10	*	AN	650	006	<10	<10	140
ECOLI 160,000 <10		CAN	97,000	000'006	2,300,000	120,000	120,000
PC		ECOLI	160,000	<10	<10	<10	2,400
EVEA <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <td></td> <td>PC</td> <td><10</td> <td><10</td> <td><10</td> <td><10</td> <td><10</td>		PC	<10	<10	<10	<10	<10
Level Cadabism 48 Hours 7 Dave 14 Davs 21 Dave AN 20 <10 <10 <10 CAN 65,000 520,000 56,000 32,000 ECOLI 26,000 520,000 56,000 32,000 PC <10 <10 <10 <10 PSA <10 <10 <10 <10 SA 12,000 <10 <10 <10 GAN 3,100 4,800 180 <10 ECOLI 45,000 <10 <10 <10 FC <10 <10 <10 <10 <td></td> <td>PSA</td> <td><10</td> <td><10</td> <td><10</td> <td><10</td> <td><10</td>		PSA	<10	<10	<10	<10	<10
Level Organism 48 Hours 7 Dave 14 Days 21 Days AN 20 <10 <10 <10 CAN 65,000 520,000 56,000 32,000 BCOLI 26,000 <10 <10 <10 PC <10 <10 <10 <10 PSA <12,000 <10 <10 <10 SA <12,000 <10 <10 <10 GAN <12,000 <10 <10 <10 <10 FEVEL <12,000 <10 <10 <10 <10 <10 AN <10 <10 <10 <10 <10 <10 <10 PC <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10<		SA	23,000	<10	<10	<10	06
Level Organism 48 Hours 7 Days 14 Days 21 Days AN 20 < 10							
AN 20 <10 <10 CAN 65,000 520,000 56,000 32,000 ECOLI 26,000 <10 <10 <10 PC <10 <10 <10 <10 SA 12,000 <10 <10 <10 AN 48 Hours 7 Days 14 Days <10 AN <10 <10 <10 <10 ECOLI 45,000 <10 <10 <10 PC <10 <10 <10 <10 PSA <10 <10 <10 <10 SA <6,000 <10 <10 <10	Level	Organism	48 Hours	7 Days	14 Days	21 Days	28 Days
CAN 65,000 520,000 56,000 32,000 ECOLI 26,000 <10	æ	AN	20	<10	<10	<10	. <10
ECOLI 26,000 <10 <10 PSA <10 <10 <10 PSA <12,000 <10 <10 SA 12,000 <10 <10 QUEGANISM 48 Hours 7 Days 14 Days <10 AN <10 <10 <10 <10 CAN 3,100 4,800 180 640 ECOLI 45,000 <10 <10 <10 PC <10 <10 <10 <10 PSA <6,000 <10 <10 <10 SA <6,000 <10 <10 <10		CAN	65,000	520,000	56,000	32,000	370,000
PC <10 <10 <10 <10 SA 12,000 <10 <10 <10 SA 12,000 <10 <10 <10 Qrganism 48 Hours 7 Days 14 Days 21 Days AN <10 <10 <10 <10 CAN 3,100 4,800 180 <40 ECOLI 45,000 <10 <10 <10 PC <10 <10 <10 <10 PSA <6,000 <10 <10 <10 SA <6,000 <10 <10 <10		ECOLI	26,000	<10	<10	<10	<10
PSA < 12,000 < 10 < 10 SA 12,000 < 14 Days 21 Days Qrganism 48 Hours 7 Days 14 Days 21 Days AN < 10 < 10 < 10 CAN 3,100 4,800 180 640 ECOLI 45,000 < 10 < 10 < 10 PC < 10 < 10 < 10 < 10 PSA < 6,000 < 10 < 10 < 10 SA 6,000 < 10 < 10 < 10		PC	<10	<10	<10	<10	. <10
SA 12,000 <10 <10 Organism 48 Hours 7 Days 14 Days 21 Days AN <10 <10 <10 <10 CAN 3,100 4,800 180 640 ECOLI 45,000 <10 <10 <10 PC <10 <10 <10 <10 PSA <10 <10 <10 <10 SA <6,000 <10 <10 <10		PSA	<10	<10	<10	<10	<10
Organism 48 Hours 7 Days 14 Days 21 Days AN <10	٠	SA	12,000	<10		<10	<10
Organism 48 Hours 7 Days 14 Days 21 Days AN <10							
<10	Level	Organism	48 Hours	7 Days	14 Days	21 Days	28 Days
3,100 4,800 180 640 4, 45,000 <10		AN	<10	<10	<10	<10	<10
45,000 <10		CAN	3,100	4,800	180	640	4,400
<10		ECOLI	45,000	<10	<10	<10	<10
<pre> <10 <10 <10 <10 <10 <10 <10 <10</pre>	-	PC .	<10	<10	<10	<10	<10
6,000 <10 <10 <10		PSA	<10	<10	<10	<10	. <10
		SA	6,000	<10	<10	<10	<10

ABLE 22 (CONT)

Test Level	Organism	48 Hours	7 Days	14 Days	21 Days 2	28 Days
0.2%	AN	<10	<10	<10	<10	<10
2	CAN	<10	<10	<10	<10	<10
	ECOLI	<10	<10	<10	<10	<10
=	PC	<10	<10	<10	<10	<10
2	PSA	<10 .	<10	<10	<10	<10
. =	SA	180	<10	<10	<10	<10
Unpreserved control	ontrol					
Organism	48 Hours	7 Days	14 Days	21 Days	28 Days	
AN	37,000	36,000	24,000	5,200	000'9	
CAN	120,000	1,900,000	3,300,000	480,000	790,000	
ECOLI	150,000	2,500,000	7,300,000	240,000	140,000	
PC	19,000,000	15,600,000	5,900,000	8,500,000	31,000,000	
PSA	<10	<10	100	15,200	300,000	
SA	7,000,000	>1,000,000	12,000	3,000	110	
Inoculum Concentration	entration					
Organism		0 Hours	21 Days	.,		
AN		20,000	41,000			
CAN	п	1,400,000	640			
ECOLI	4	4,800,000	5,800,000	. •		
PC	u	9,200,000	000,006			
PSA	•	000,006,9	000'000'6			
SA	u)	5,700,000	7,200,000			

			TABLE 23			
			2000:1 GADM/IPBC	PBC		
Test Level	Organism	48 Hours	7 Days	14 Days	21 Days	28 Days
0.025%	AN	300	21	10	<10	11
=	CAN	480,000	890,000	940,000	1,040,000	130,000
=	ECOLI	230,000	<10	<10	<10	<10
=	PC	<10	<10	<10	<10	<10
	PSA	<10.	<10	<10	<10	<10
=	SA	78,000	<10	<10	<10	<10
			ı		•	
Test Level	Organism	48 Hours	7 Days	14 Days	21 Days	28 Days
0.05%	AN	<10	<10	. <10	<10	<10
=	CAN	110,000	4,100,000	3,600,000	330,000	97,000
=	ECOLI	120,000	<10	<10	<10	<10
	PC	<10	<10	<10	<10	<10
=	PSA	<10	<10	<10	<10	<10
E	SA	26,000	<10	<10	<10	<10
					i.,	
Test Level	Organism	48 Hours	7 Days	14 Days	21 Days	28 Days
0.1%	AN	<10.	<10	<10	<10	<10
	CAN	1,200,000	53,000	430,000	144,000	110,000
=	ECOLI	<10	<10	<10	<10	<10
2	PC	<10	<10	<10	<10	<10
=	PSA	<10	<10	<10	<10	<10
=	SA	<10	<10	<10	<10	<10

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28 Days	<10	09	<10	<10	<10	<10		•	•								 :					
21 Days 28	<10	<10	<10	<10	<10	<10		28 Days	5,400	170,000	140,000	1,400,000	100,000	80								
14 Days 21	<10	<10	<10	<10	<10	<10		21 Days	13,000	200,000	920,000	10,000,000	12,800	7,100								
7 Days 1	<10	<10	<10	<10	<10	<10		14 Days	33,000	780,000	920,000	10,000,000	12,800	7,100		21 Days	10,000	310,000	3,500,000	2,500,000	5,400,000	4,100,000
48 Hours	<10	000'06	<10	<10	<10	<10		7 Days	33,000	780,000	3,100,000	30,000,000	009	410,000		0 Hours	53,000	1,900,000	170,000	87,000	390,000	200,000
Organism	AN	CAN	ECOLI	PC	PSA	SA	control	48 Hours	20,000	780,000	000,009	11,000,000	3,800	14,000,000	ncentration		i et	'				
Test Level	0.2%	E	2	2	:	=	Unpreserved control	Organism	AN	CAN	ECOLI	PC	PSA	SA	Inoculum Concentration	Organism	AN	CAN	ECOLI	PC	PSA	SA

Discussion of Challenge Testing Results

The 28-day challenge results reported in Tables 15-23 above demonstrate the effectiveness of the preservative admixture of the invention in a use emulsion composition against a wide range of bacteria and fungi organisms.

For example, admixture compositions of Germall® II and IPBC at a wt. ratio of 2000:1 (Table 15), when present at use levels of 0.05 to 0.2%, corresponding to 0.75 to 10 ppm IPBC and 500 to 2000 ppm methylol levels, provide substantially complete protection against all tested organisms after 28 days. At the low use level of 0.05% active, all the challenge tests passed within 21 days. Then, upon reinoculation after 21 days, all organisms died within 7 days except CAN which cleared within 14 days.

Table 21 shows the challenge test results for DMDMH and IPBC admixtures at the same 2000:1 wt. ratio. A use level of 0.2%, however, is needed for this blend to pass against all organisms after 21 days. Upon reinoculation, all organisms died within 7 days with the exception of CAN which cleared within 14 days. It is thus evident from these results that Germall® II blended with IPBC is 4 times more effective than a DMDMH/IPBC blend.

Germall[®] II also is superior to GADM as the methylol compound, as shown in Table 23.

Table 24 below is a study of the activity of solution of GII/IPBC in propylene glycol. The admixtures of the active GII and IPBC components were prepared at weight ratios of 99.5%/0.5% and 99%/1%, and added to 60% by weight propylene glycol. The resulting solutions were tested at 0.05%, 0.1% and 0.2% total active in a proteinaceous shampoo formulation.

TABLE 2

99.5% GII/0.5%	IPBC/propyle	99.5% GII/0.5% IPBC/propylene glycol solution - 0.05% total active	ion - 0.05%	total active		
Test Level	Organism	48 Hours	7 Days	14 Days	21 Days	28 Days
0.05%	AN	310,000	2,000	<10	<10	<10
=	CAN	44,000	2,400	<10	<10	1,800
3 ,	ECOLI	3,000	<10	<10	<10	<10
=	PC	400,000	62,000	06	<10	>10,000
=_	PSA	5,300,000	3,000	<10	<10	>10,000
=	SA	10	10	<10	<10	<10
Test Level	Organism	Test Level Organism 48 Hours 7 Days 14 Days	7 Days	14 Days	21 Days	28 Days
0.18	AN	210,000	<10	<10	<10	<10
	CAN	1,500	<10	<10	<10	<10
	ECOLI	580	<10	<10	<10	20
=	PC	34,000	<10	<10	<10	<10
=	PSA	780	<10	<10	<10	<10
=	SA	<10	<10	<10	<10	<10

	28 Days	<10	<10	<10	<10	<10	<10	.,	28 Days	<10	20	9	3,400	280	<10			28 Days	<10	<10	<10	<10	<10	<10
	21 Days	<10	<10	<10	<10	<10	<10	٠	21 Days	<10	<10	<10	<10	<10	<10	٠.		21 Days	<10	<10	<10	<10	<10	<10
otal active	14 Days	<10	<10	<10	<10	<10	<10	1 active	14 Days	<10	<10	<10	<10	<10	<10	440	acc+ va	14 Days	<10	<10	<10	<10	<10	<10
cion - 0.2% to	7 Days	<10	<10	<10	<10	<10	<10	- 0.05% total active	7 Days	<10	<10	<10	<10	<10	<10	1 O 19 total active	10101 67.0	7 Days	<10	<10	<10	<10	<10	<10
ne glycol solut	48 HOULE	<10	<10	<10	<10	<10	<10	lycel selution	48 Hours	89,000	4,400	3,300	260,000	64,000	<10	. colitton	11011NT BOTONTO	48 Hours	37,000	<10	840	48,000	440	<10
99.5% GII/0.5% IPBC/propylene glycol solution - 0.2% total active	Organism	AN	CAN	ECOLI	Dđ	PSA	SA	99% GII/1% IPBC/propylene glycol solution	Organism	AN	CAN	ECOLI	PC	PSA	SA	00% GII/1% TOBG/bronvlene Alveol ecliption	אין או מהג זבוום א	Organism	AN	CAN	ECOLI	50	PSA	SA
99.5% GII/0.5	Test Level	0.2%	=	:	-	=		99% GII/1% IP	Test Level	0.05%	=	= .	=	E	=	008 CTT/18 TD	220 G41/49 45	Test Level	0.18	=	=	=	=	=

66	\$ GII/1\$ 1	PBC/propylene	99% GII/1% IPBC/propylene glycol solution - 0.2% total active	- 0.2% total			
Te	Test Level	Organism	48 Hours	7 Days	14 Days	21 Days	28 Days
0	0.2%	AN	<10	<10	<10	<10	<10
	=	CAN	<10	<10	<10	<10	<10
	=	ECOLI	<10	<10	<10	<10	<10
	=	PC	<10	<10	<10	<10	<10
•		PSA	<10	<10	<10	<10	<10
	=	SA	<10	<10	<10	<10	<10
un	Unpreserved control	control					
OL	Organism	48 Hours	7 Days	14 Days	21 Days	28 Days	1
A.		4,000,000					
CAN	z	160,000	>100,000,001<	2,600,000	>100,000,000	>1,000,000	
DE EC	ECOLI		>100,000,000	800,000,008	48,000,000	600,000	_
PC		>100,000,000	20,000,000	48,000,000		>1,000,000	
PSA	Æ	>100,000,000	>100,000,000	58,000,000	65,000,000	>1,000,000	
SA			>100,000,001<	,			-
In	oculum Cor	Inoculum Concentration		,		: :	•
N N	Organism		0 Hours	21 Days			
AN			380,000	330,000			
CAN	Z,		860,000	4,200,000	. •		
ည္သ	ECOLI	2,	2,500,000	5,300,000	ı		
PC		1,	000,006,1	000,000,09			
PSA	Ą	3,	3,200,000	2,000,000			
SA		2,	2,400,000	3,000,000			

Table 25 shows a similar study as in Table 24 above in which the vehicle for the composition was the typical emulsion described above.

TABLE 25

99.5% GII/0.5%	IPBC/propylene glycol solution - 0.05% total active	glycol soluti	on - 0.05%	total active		
Test Level	Organism	48 Hours	7 Days	14 Days	21 Days	28 Days
0.05%	AN	40	<10	<10	<10	<10
=	CAN	520,000	<10	<10	<10	<10
=	ECOLI	320	<10	<10	<10	<10
=	PC	<10	<10	<10	<10	<10
= .	PSA	<10	<10 .		<10	<10
*	SA	24,000	<10 \		<10	<10
99.5% GII/0.5%	11	glycol soluti	on = 0.1% t	otal active	of Dave	SyeC ac
Taker 1ser	Ordanism	S THOU S	/ Days	TA Days	ST Days	48 Days
0.1%	AN .	<10	<10	<10	<10	<10
=	CAN	<10	<10	<10	<10	<10
=	ECOLI	10	<10	<10	<10	<10
	Dd	<10	<10	<10	<10	<10
=	PSA	<10	<10	<10	<10	<10
	SA	650	<10	<10	<10	<10

99.5% GII/0.5%	IPBC/propylen	99.5% GII/0.5% IPBC/propylene glycol solution - 0.2% total active	ton - 0.2%	cotal active		
Test Level	Organism	48 Hours	7 Days	14 Days	21 Days	28 Days
0.2%	AN	<10	<10	<10	<10	<10
=	CAN	<10	<10	<10	<10	<10
2	ECOLI	<10	<10	<10	<10	<10
=	PC	<10	<10	<10	<10	<10
=	PSA	<10	<10	<10	<10	<10
=	SA	<10	<10	<10	<10	<10
99% GII/1% IPBC/propylene glycol solution	C/propylene gl		- 0.05% total active	l active		
Test Level	Organism		7 Days	14 Days	21 Days	28 Days
0.05\$	AN	<10	<10	<10	<10	<10
	CAN	6,700	<10	<10	<10	<10
5	ECOLI	66,000	<10	<10	<10	<10
₽,	PC	<10	<10	<10	<10	<10
	PSA	<10	<10	<10	<10	<10
S.	SA	20,000	<10	<10	<10	<10
841 \$17115 \$66	IPBC/propylene glycol solution	ycol solution	- 0.1% total	active		
Test Level	Organism	48 Hours	7 Days	14 Days	21 Days	28 Days
0.1\$	AN	<10	<10	<10	<10	<10
	CAN	<10	<10	<10	<10	<10
E	ECOLI	<10	<10	<10	<10	<10
	PC	<10	<10	<10	<10	<10
=	PSA	<10	<10	<10	<10	<10
=	SA	620	<10	<10	<10	<10

99% GII/1%	99% GII/1% IPBC/propylene glycol solution - 0.2% total active	glycol solutio	n - 0.2% tota	active		
Test Level	Organism	48 Hours	7 Days	14 Days	21 Days	28 Days
0.2%	AN	<10	<10	<10	<10	<10
=	CAN	<10	<10	<10	<10	<10
z	ECOLI	<10	<10	<10	<10	<10
=	PC	<10	<10	<10	<10	<10
=	PSA	<10	<10	<10	<10	<10
z	SA	<10	<10	<10	<10	<10
Unpreserved control	d control					
Organism	48 Hours	7 Days	14 Days	21 Days	28 Days	2
AN	3,100,000	650,000	370,000	1,400,000	260,000	00
CAN	6,000,000	4,000,000	1,100,000	5,800,000	>1,000,000	0
ECOLI	11,000,000	7,300,000	6,000,000	730,000	220,000	0
PC	100,000,000	53,000,000	40,000,000	40,000,000	600,000	0
PSA	5,000,000	200,000	2,700,000	72,000	20,000	0
SA	30,000,000	150,000	440,000	2,500	006'6	0
Inoculum Co	Inoculum Concentration					
Organism	9	O Hours	21 Days		•	
AN		380,000	330,000			
CAN	8	860,000	4,200,000			
ECOLI	2,3	2,500,000	5,300,000			
PC	1,9	1,900,000	60,000,000			
PSA	3,2	3,200,000	5,000,000			
SA	2,4	2,400,000	3,000,000			

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The results shown in Tables 24 and 25 demonstrate that the compositions of the invention are completely effective against the tested organisms in comparison to the unpreserved controls.

While the invention has been described with particular reference to certain embodiments thereof, it will be understood that changes and modifications may be made which are within the skill of the art. Accordingly, it is intended to be bound only by the following claims, in which:

WHAT IS CLAIMED IS:

- 1. A water soluble preservative antimicrobial composition for addition to commercial use products at predetermined use levels to provide synergistic biocidal activity against a wide range of fungi and gram-negative and gram-positive bacteria, comprising
 - (1) an admixture of
 - (a) one or more methylol compounds, and
- (b) 3-iodo-2-propynylbutyl carbamate, in a weight ratio of (a):(b) of 100:1 to 2000:1.
- 2. A water soluble preservative admixture according to claim 1 wherein said weight ratio is 200:1 to 500:1.
- 3. A water soluble preservative admixture according to claim 1 wherein
- (a) is N-[1,3-bis(hydroxymethyl)-2,5-dioxo-4-imidazolidinyl]-N,N'-bis(hydroxymethyl) urea, imidurea, 1,3-dimethylol-5,5-dimethyl hydantoin, sodium hydroxymethylglycinate, or glycine anhydride dimethylol.
- 4. A preservative admixture according to claim 3 wherein
- (a) is N-[1,3-bis(hydroxymethyl)-2,5-dioxo-4-imidazolidinyl]-N,N'-bis(hydroxymethyl) urea.
- 5. A composition according to claim 1 Which also includes (2) propylene glycol or 1,3-butylene glycol.

- 6. A water soluble preservative antimicrobial composition according to claim 5 which comprises about 20 to 55 weight percent of (1) and 45 to 80 weight percent of (2).
- 7. A composition according to claim 6 which comprises about 40 weight percent of (1) and about 60 weight percent of (2).
- 8. A commercial use product which is protected for an extended period of time against contamination by a wide range of fungi and gram-negative and gram-positive bacteria which includes 0.01 to 0.5% by weight of the water soluble preservative composition of claims 1-7.
- 9. A commercial use product according to claims 1-8 which includes about 0.1% by weight of the water soluble preservative composition of claim 2 or 5.
- 10. A commercial use product according to claims 1-9 in which said composition is water solubilized and uniformly distributed throughout said composition.
- 11. A commercial use product according to claims 1-10 in which (b) is present therein in an amount of 0.5 to 10 ppm, and (a) is present in an amount of at least 250 ppm.

Carrier System of Confidences

- 12. A commercial use product according to claims 1-11 which is a personal care, household or industrial composition.
- 13. A commercial use product which is protected for an extended period of time against contamination by a wide range of fungi and gram-negative and gram-positive bacteria which includes 0.1 to 5% by weight of the composition of claims 1-12.
- 14. A product according to claim 13 which includes about 0.5 to 1% by weight of the composition of claim 1 or 5.